

Biology HL P3 TZ1

2008 May

School Level 12th IB Diploma

Programme

Board Exam

International Baccalaureate (IB

Board)

Solved

**BIOLOGY
HIGHER LEVEL
PAPER 3**

Thursday 15 May 2008 (morning)

1 hour 15 minutes

Candidate session number

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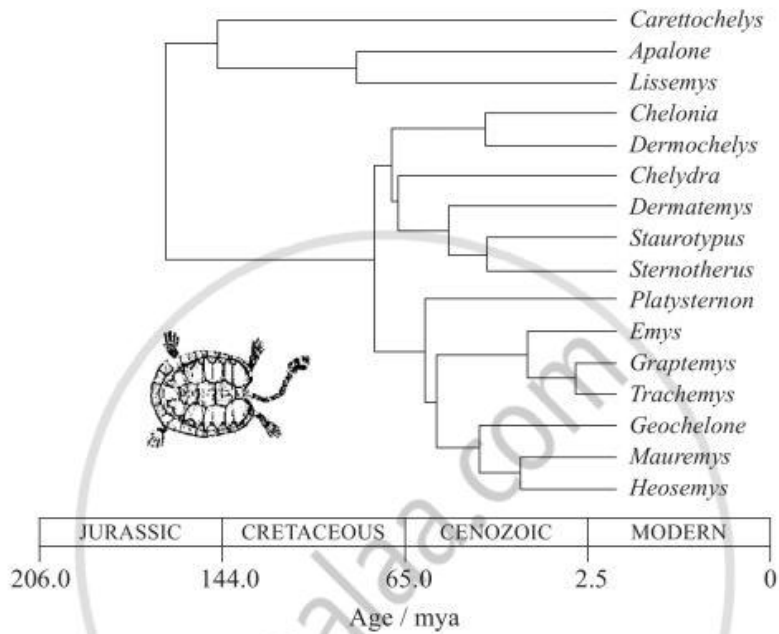
INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.



Option D — Evolution

D1. Molecular and radioactive dating of fossils are used to determine the phylogeny of organisms. Turtles are organisms with a long evolutionary history, making them an ideal group to study. Below is a phylogeny of some turtle genera developed using both fossil and molecular dating.



[Source: Thomas J. Near, Peter A. Meylan, and H. Bradley Shaffer, 'Assessing Concordance of Fossil Calibration Points in Molecular Clock Studies: An Example Using Turtles', *The American Naturalist* (Feb 2005), vol. 165, issue 2, pp. 137–146. Copyright © 2008, University of Chicago Press.]

(a) Identify the oldest turtle genus. [1]

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(b) Compare the phylogeny of *Chelonia* with *Graptemys*. [2]

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(Question D1 continued)

- (c) Discuss which turtle genera are most closely related. [3]

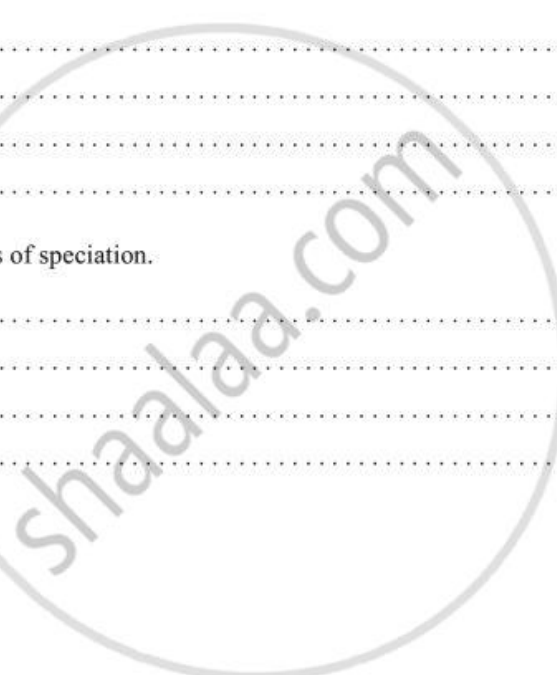
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- D2. (a) Discuss the difficulties for biologists in defining the term *species*. [2]

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- (b) Outline the process of speciation. [2]

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D3. (a) Describe the physical features of humans that define them as primates. [4]

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(b) Discuss the evidence for the theory that modern humans are descended from African apes. [6]

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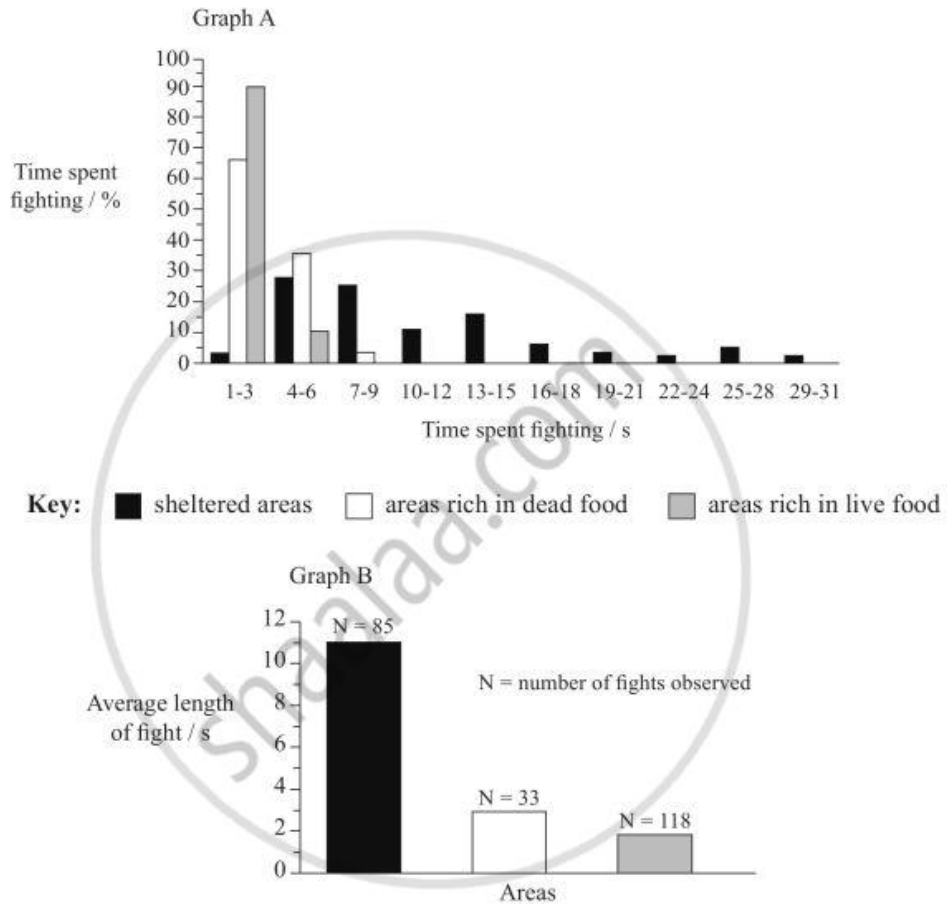
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Option E — Neurobiology and Behaviour

E1. Crayfish are crustaceans known for their aggressive behaviour. Researchers observed this aggressive behaviour to determine what was most important to the crayfish of genus *Orconectes*: shelter, dead food source, or live food source. The researchers recorded the number of fights and the length of time pairs of crayfish spent fighting in three different areas.



[Source: Figure 1 from Bergman, D. A., and P. A. Moore. 2003. Biol. Bull. 205: 26-35. Reprinted with permission from the Marine Biological Laboratory, Woods Hole, MA.]

- (a) Using the data in graph A, compare the percentage of time the crayfish spent fighting in sheltered areas and areas rich in live food. [2]

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(Question E1 continued)

- (b) (i) Identify the average length of a fight in sheltered areas and areas rich in dead food. [1]
sheltered:
rich in dead food:
- (ii) Calculate the ratio of the average fight length in areas rich in dead food to the average fight length in sheltered areas. [1]

Answer:

- (c) Discuss which areas are preferred by the crayfish. [3]
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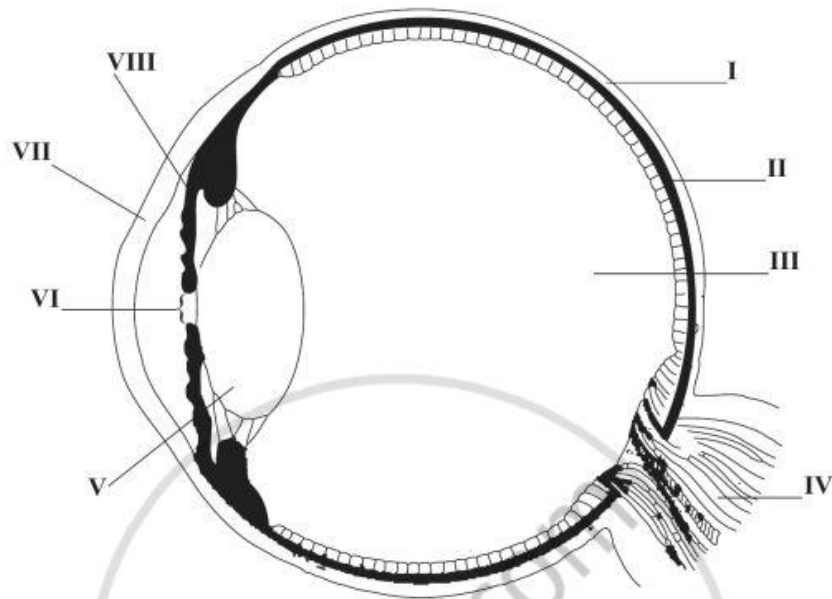
- E2. (a) Define the term *imprinting*. [1]
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- (b) Outline Lorenz's experiments on imprinting in geese. [2]
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E3. (a) Annotate the diagram below of the human eye.

[4]



- I:
- II:
- III:
- IV:
- V:
- VI:
- VII:
- VIII:

(b) Explain the role of the sympathetic and parasympathetic systems in the body, using the control of the eye to illustrate your answer.

[6]

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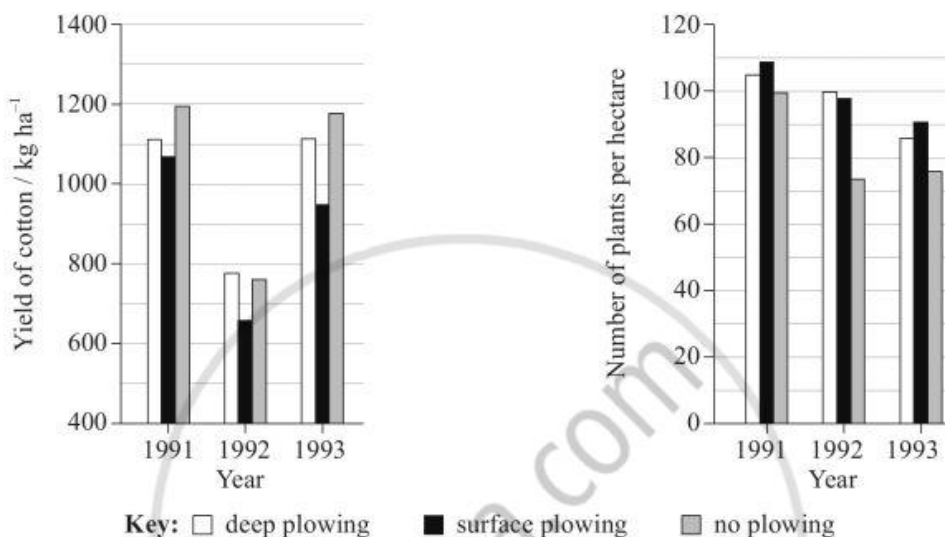
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Option F — Applied Plant and Animal Science

F1. The reduction of plowing (the preparation of soil) ahead of planting crops reduces production costs and improves soil productivity. Scientists investigated the effect of different plowing methods on cotton production. The results below show the impact of deep, surface and no plowing methods on cotton yield and plant population numbers.



[Source: Charles W Kennedy and Robert L Hutchinson, *Crop Science*, (2001) page 1162. Figures used with permission.]

(a) (i) Calculate the average number of cotton plants per hectare in 1992 regardless of the plowing method used. [1]

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(ii) Suggest a reason why cotton yield was lower in 1992 than in 1991 or 1993. [1]

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(b) Compare the yield of cotton with the number of plants during the study period. [2]

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(Question F1 continued)

- (c) Using the data, discuss what advice should be given to farmers regarding plowing methods. [2]

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- F2.** (a) Explain the role of auxin in phototropism. [2]

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- (b) Describe the commercial use of plant growth regulators. [2]

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F3. (a) Describe **two** examples of transgenic techniques in agriculture. One example must be in plants and the other in animals. [6]

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(b) Discuss the ethical issues arising from the use of transgenic techniques in agriculture. [4]

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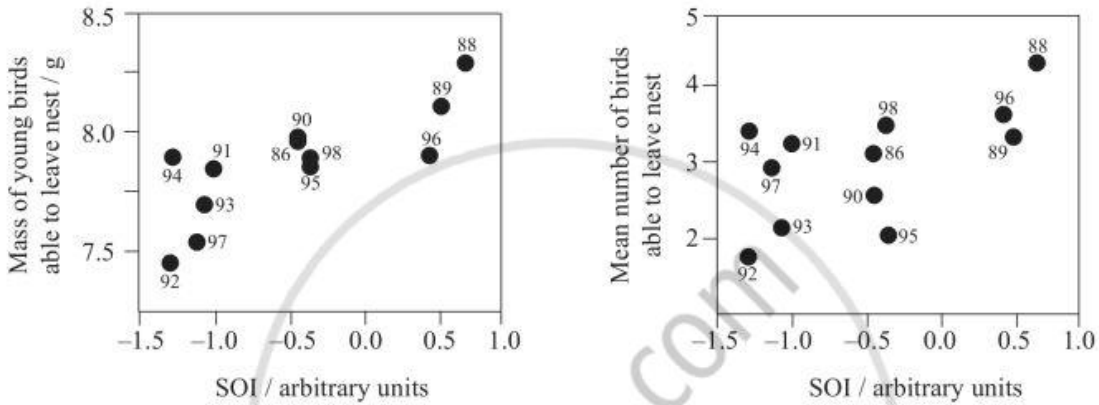
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Option G — Ecology and Conservation

G1. The Southern Oscillation Index (SOI) is an indicator of global climate cycle changes. Large negative values indicate warmer than normal weather (El Niño), whereas large positive values suggest colder than normal weather (La Niña).

Between 1988 and 1998, scientists studied the effect of changes in the SOI on *Dendroica caerulescens*, the black-throated blue warbler, a migratory songbird. Each dot in the diagrams represents the mean value calculated for that year.



[Source: T. Scott Sillett et al., 'Impacts of a Global Climate Cycle on Population Dynamics of a Migratory Songbird', Science, (16 June 2000), vol. 288, issue 5473, pp. 2040 – 2042. Reprinted with permission from AAAS.]

(a) State the average mass of juvenile birds leaving their nest in 1989. [1]

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(b) Compare the relationship between young birds' mass and mean number of birds able to leave the nest. [2]

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(c) Discuss the implications of global climate changes for the warblers. [3]

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G2. Describe the principle of competitive exclusion.

[3]

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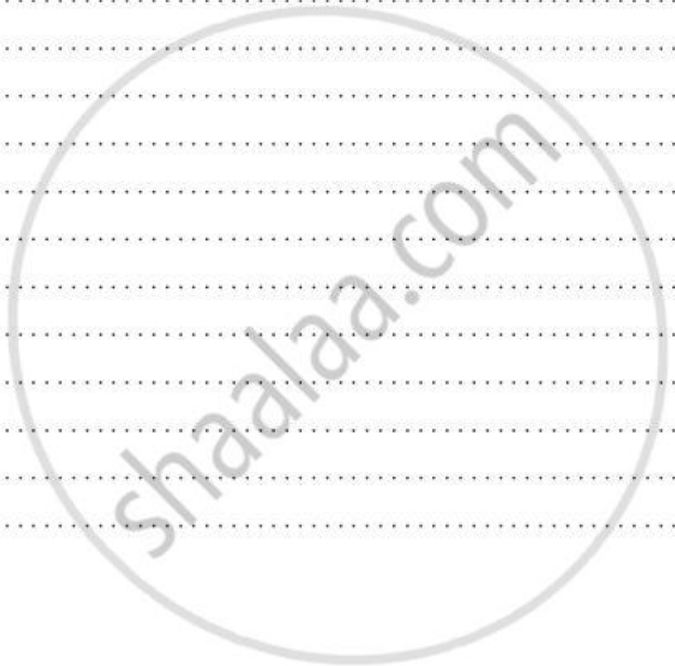


G3. (a) Outline the factors that caused the recent extinction of a named animal. [4]

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(b) Discuss reasons for the conservation of biodiversity using rainforests as your example. [7]

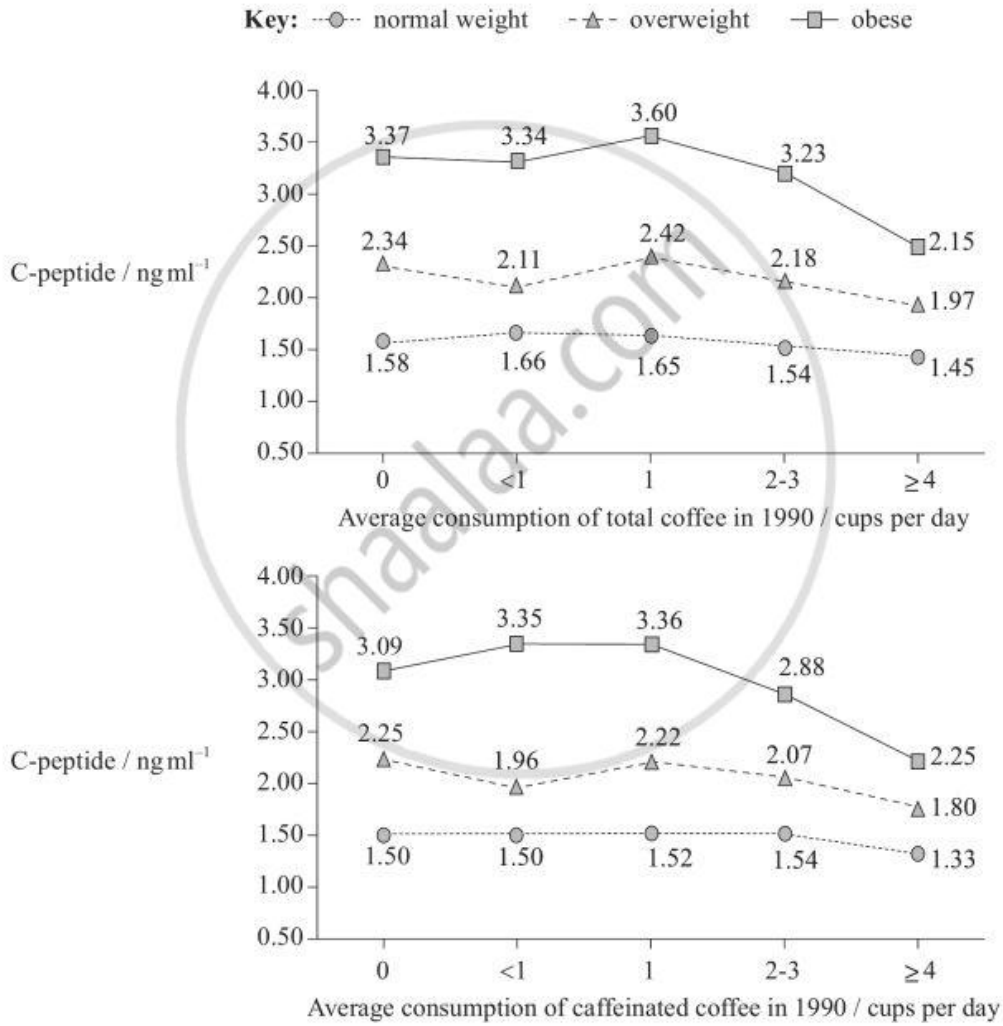
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Option H — Further Human Physiology

H1. Reduced risk of Type 2 diabetes has been associated with coffee consumption. A compound called C-peptide is found in the bloodstream when insulin is released. Increased C-peptide levels are associated with Type 2 diabetes.

The following study investigated the effect of coffee consumption on blood plasma concentration of C-peptide in women. The subjects were grouped according to their weight and their level of coffee consumption. The study investigated both total coffee consumption (caffeinated and decaffeinated coffee) and consumption of caffeinated coffee.



[Source: Tianying Wu *et al.*, *Diabetes Care*, (2005), 7, page 1390 Copyright © 2005 American Diabetes Association. From *Diabetes Care*, Vol. 28, 2005: 1390-1396. Reprinted with permission from The American Diabetes Association]

(This question continues on the following page)



(Question H1 continued)

- (a) Describe the relationship between C-peptide concentration and total coffee consumption. [2]

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- (b) Compare the effect on C-peptide concentrations in women who drink more than 4 cups of caffeinated coffee per day with those who drink no caffeinated coffee. [2]

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- (c) Using the data provided, suggest advice that could be given to women in order to reduce the incidence of Type 2 diabetes. [2]

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- H2.** (a) Define the term *partial pressure*. [1]

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- (b) Outline how the body acclimatizes to high altitudes. [3]

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H3. (a) Draw a labelled diagram of the structural features of exocrine glands.

[3]

(b) Explain the control of thyroxine by negative feedback.

[7]

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MARKSCHEME

May 2008

BIOLOGY

Higher Level

Paper 3

13 pages

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Subject Details: Biology HL Paper 3 Markscheme**Mark Allocation**

Candidates are required to answer questions from **TWO** of the Options [**2 × 20 marks**].
Maximum total = [**40 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/) – either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).
10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper. Indicate this by writing **-1(U)** at the first point it occurs and **U** on the cover page.

Option D — Evolution

- D1.** (a) *Carettochelys* [1]
- (b) both have a common ancestor/common ancestor in the cretaceous/ancestral line evolved in the Jurassic;
Chelonia has 3 divergence points from ancestor whereas *Graptemys* has five;
Graptemys has more recently diverged than *Chelonia* / *Graptemys* evolved later than *Chelonia*; [2 max]
- (c) *Graptemys* and *Trachemys*;
 (as) these separated most recently;
Graptemys and *Trachemy* are closely related to *Emys* / *Mauremys* and *Heosemys* are also closely related but diverged further back in time;
 lack of fossil evidence to show that other pairs could be more closely related;
 reliability of molecular dates could be questioned/reliability of fossil dates could be questioned; [3 max]
- D2.** (a) species are organisms that can successfully reproduce with each other / exist in reproductive isolation;
 definition originally based on morphological features;
 organisms that appear different are able to interbreed successfully / organisms that appear to be identical cannot interbreed successfully;
 asexual reproduction / fossils difficult to classify;
 clines/ring species mentioned; [2 max]
- (b) an existing population is split;
 leading to reproductive isolation;
 each resultant population may have different selection pressures / acted on by natural selection;
 leading to change in each group over time until they eventually can no longer interbreed; [2 max]
- D3.** (a) forward facing eyes / stereoscopic vision;
 grasping limbs/opposable thumbs;
 upright (sitting) posture;
 nails on some digits;
 small/single number of young per pregnancy;
 mobile arms with shoulder joints allowing movement in three planes; [4 max]
Do not accept "neoteny" and "bipedalism".

- (b) fossils show evolutionary trends from African apes to modern humans;
development of adaptations to bipedalism;
increasing brain size;
the oldest (pre-) human fossils are found in Africa;
humans and African apes molecular studies suggest that humans are closely related/more closely related than with other apes;
different hypotheses for development continue to be proposed;
named fossil examples;
named molecular DNA *e.g. Homo habilis* fossils found in Africa;
neoteny found in both groups;

[6 max]



Option E — Neurobiology and Behaviour

- E1.** (a) crayfish fight for shelter much longer than for live food;
 crayfish fight for shelter for up to 29 - 31 seconds/up to 31 seconds;
 but only 4-6 seconds/6 seconds for live food;
 1-3 second fights are 90 % of fights for live food but only 4 % of fights for shelter;
 other valid comparison; **[2 max]**
- (b) (i) sheltered = 11s; (*units required*)
 rich in dead food = 3s; (*units required*) **[1]**
Both required for [1].
- (ii) 3:11/1:3.67/0.27 **[1]**
- (c) shelter preferred;
 fights for shelter are longest fights;
 little difference between fight time length for dead food and live food;
 live food is least favoured as average fight duration shortest;
 pressure of predators could make shelter preferred; **[3 max]**
- E2.** (a) a learned behaviour that develops as a response to stimulus during a sensitive period (of development) **[1]**
- (b) Lorenz hatched geese and stayed with them in their first few hours after birth (the sensitive period);
 the goslings responded to the stimuli of seeing Lorenz move about by following him;
 the goslings responded to an innate releasing mechanism / species specific behavior / a sign stimulus; **[2]**
- E3.** (a) *Award [1] for every two structures correctly labelled.*

I	Sclera;
II	Choroid;
III	Vitreous humour;
IV	Optic nerve;
V	Lens;
VI	Pupil;
VII	Cornea;
VIII	Iris;

[4 max]

(b) **[3 max]**

controlled by the autonomic system/ involuntary;
parasympathetic NS and sympathetic NS make up the autonomic NS;
the sympathetic NS prepares for threat and the parasympathetic brings it back to the norm;
antagonistic systems;
acetylcholine is a neurotransmitter for parasympathetic NS;
noradrenaline for sympathetic NS;

[3 max]

iris of the eye;
parasympathetic causes circular muscles to contract;
pupil smaller/protecting the retina from excess light;
sympathetic causes radial muscles to contract;
allowing more light to enter the pupil/better images;
allow for accommodation of the eye;

[6 max]



Option F — Applied Plant and Animal Science

- F1.** (a) (i) 90 (\pm 3) [1]
- (ii) less rain than other years / disease pests / other reasonable answer [1]
- (b) in 1992 the yield of cotton dropped whereas number of plants altered little/decreased slightly;
in 1993 yield increased above 1992 whereas the number of plants continued to fall; [2 max]
- (c) farmers should avoid plowing because any form of plowing will result in decreased yield/productivity;
surface plowing was most damaging to yield deep plowing was better than surface plowing;
deep plowing was less damaging to yield than surface plowing/deep plowing was better than surface plowing; [2 max]
- F2.** (a) auxin moves/is transported to the opposite side of the stem away from the light/
auxin inhibitor on the side closest to light;
reference to hydrogen ions absorbed;
causes cells to elongate;
results in bending towards light; [2 max]
- (b) auxin: for rooting / weed killers;
ethylene/ ethane: to speed up fruit ripening;
auxin/gibberellins: to produce seedless fruit;
[1] for the growth regulator and [1] for its (correct) effect. [2 max]
- F3.** (a) *Plant example [3 max]*
example: glyphosate/glyphosphate (weed killer) resistance in cotton;
method: gene for glyphosate/glyphosphate resistance transferred to cotton producing transgenic cotton plant;
effect: GM cotton can be sprayed with glyphosate/glyphosphate weed killer, weeds die but crop unaffected;
- Animal example [3 max]*
example: human blood clotting factor in sheep milk (pharm animal);
method: human gene for blood clotting factor transferred to sheep producing transgenic sheep;
effect: sheep produces human blood clotting factor in milk, factor separated from milk for use in humans;
- other plant examples:* salt tolerance in tomato plants, delayed ripening in tomatoes, BT maize;
other animal examples: Alpha- 1 antitrypsin; [6 max]

- (b) *Arguments for: [3 max]*
allows for cheap mass production of life saving vaccines/proteins/hormones;
GMO's are kept out of natural ecosystems / carefully chosen;
the process occurs naturally anyway with far less control;

Arguments against: [3 max]
long term effects cannot be known;
genes could transfer to wild organisms causing rogue organisms that have
unknown impact;
causes unnecessary suffering in animals;

[4 max]



Option G — Ecology and Conservation

- G1.** (a) 8.1(± 0.1) gms (*units required*) **[1]**
- (b) strong correlation (between fledgling mass and birds able to leave nest);
in years where mass is low, number leaving nest is low / *vice versa*;
use of data to support comparison; **[2]**
- (c) Warblers favour high SOI/La Niña (*or vice versa*);
more years (in the study) were negative SOI (*or vice versa*);
indicating a possible decline in Warblers;
SOI is a good predictor of Warbler reproductive success; **[3]**
- G2.** no two species can occupy the same niche;
organisms occupying the same niche in a habitat will compete for same resources;
one species will have a greater advantage/succeed better in competing (for resources);
the species with the advantage will occupy the niche, the other will die out or move;
named example *e.g. Balanus balanoides* and *Chthamalus stellatus*; **[3 max]**
- G3.** (a) *Example: e.g. The Dodo*;
species isolated on an island / Indian Ocean island / Mauritius;
destruction of the forest;
and the animals that European sailors brought with them, including cats, rats, and pigs, which destroyed Dodo nests;
eaten by humans;
flightless therefore easily caught; **[4 max]**
- (b) rainforests hold the greatest known diversity of organisms;
the complexity of rainforest ecosystems is enormous / not well understood;
organisms are adapted to their environment / replacement species are unlikely to be as well adapted;
organisms are interdependent / removal of one often has major impacts on others;
impacts of removal of species are often unforeseen;
destruction of rainforests is often followed by land degradation / landslides / river silting / flash flooding;
many valuable commodities can be harnessed from rainforests in a sustainable manner (*e.g. pharmaceutical products*);
the genetic pool of rainforests is not fully explored;
aesthetic beauty of rainforests;
ecotourism is a valuable trade; **[7 max]**

Option H — Further Human Physiology

- H1.** (a) as coffee consumption increased C-peptide concentration dropped;
at all levels of coffee consumption obese women have higher C-peptide levels than overweight /normal weight women;
highest value of C-peptide at <1-1 cup of coffee per day / for obese and overweight women the highest value is 1 cup / for normal weight the highest value is at <1 cup / most effect is seen when more than 3 cups are consumed; [2]
- (b) for all women drinking more that 4 cups of caffeinated coffee a day there is less C-peptide that in those who drink no coffee;
the difference is greatest in obese women/ least in normal weight women; [2]
- (c) women should be recommended to drink 4 cups of caffeinated coffee per day;
women should try to reduce their weight; [2]
- H2.** (a) the pressure of a single gas in the mixture as if that gas alone occupied the container / the pressure exerted by a single gas in a mixture of gases; [1]
- (b) ventilation rate increases;
red blood cell / erythrocyte concentration in blood increases;
myoglobin concentration in muscles increases;
capillary networks develop greater density;
lung capacity increases; [3 max]
- H3.** (a) secretory cells/acinus;
secretory vesicles;
lumen/duct/lumen of duct; [3]
Award [1 max] for each structure clearly drawn and correctly labelled.
- (b) thyrotropin releasing hormone (TRH) produced in the hypothalamus;
transported to the (anterior) pituitary in the portal vein;
secretion of thyroxine stimulating hormone (TSH) by the (anterior) pituitary;
thyroxine stimulating hormone brings about the secretion of thyroxine from the thyroid gland;
two forms exist/ T3, T4;
released into the bloodstream;
causes an increase in metabolic rate;
thyroxine inhibits the production/release of thyroxine releasing hormone/thyroxine stimulating hormone;
increased metabolic rate/rise in body temperature monitored by hypothalamus/
causes decreased production of TRH;
thyroxine levels maintained within narrow limits; [7 max]